The Poor Man's Soldering Iron

By Rubbish Raider (/member/Rubbish+Raider/) in Technology (/technology/) > Soldering (/technology/soldering/) 31,868 254 30 Featured

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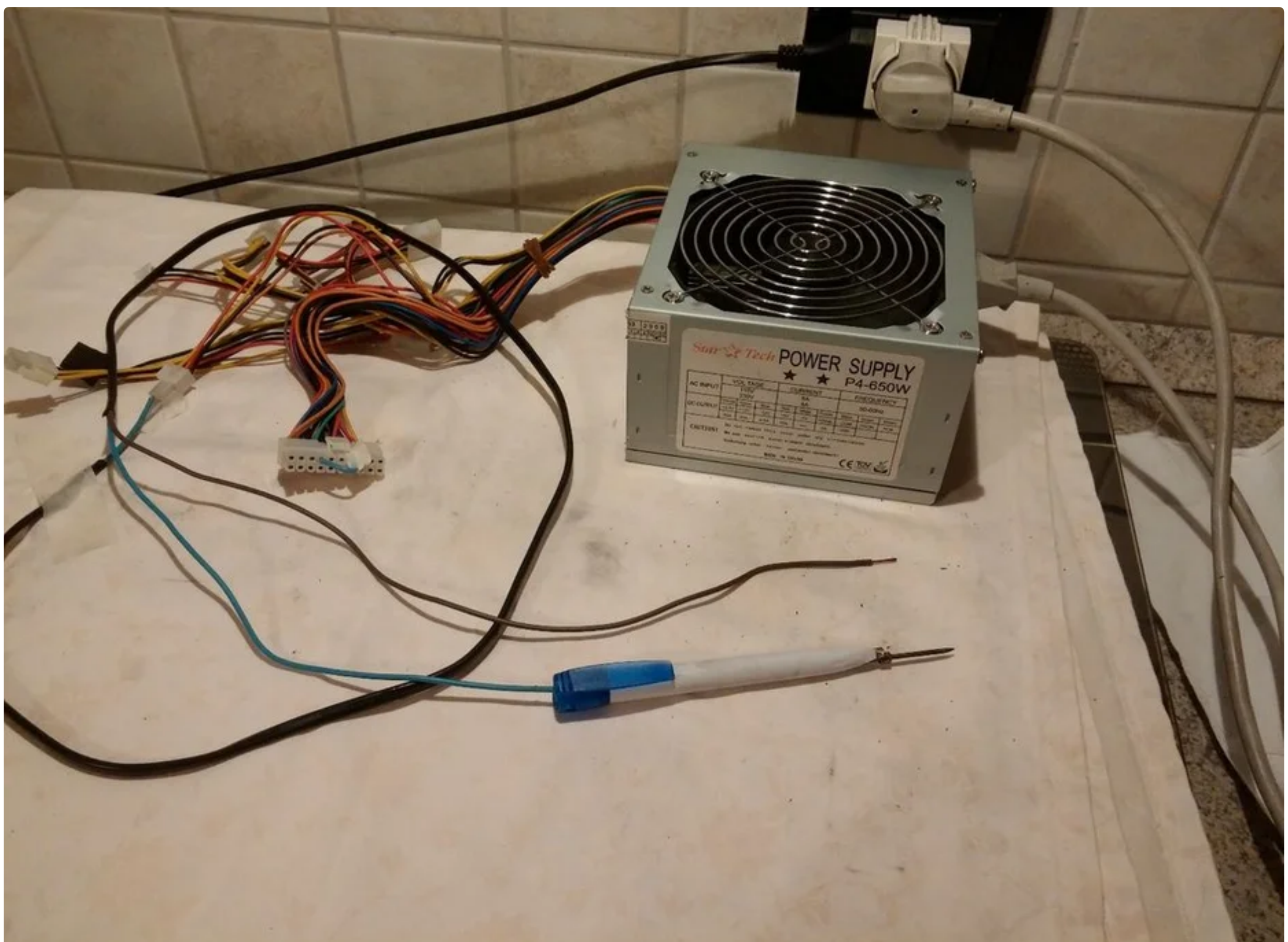

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Welcome to my first instructable! As said in the title, I will try to teach you how to build a simple soldering iron at little to no expense. "Why should I build a soldering iron instead of buying one?" Apart from the little cost of the project (most people can manage to assemble their soldering iron for free, or almost free) this instructable is for those who like to understand how stuff work, who like to build their tools, and for those (like me) who just

broke their soldering iron and needed a quick solution to finish their Arduino project.

The idea came from the "DIY Cold Heat soldering iron" instructable by photozz, for which I thank him very very much. Unfortunately, I didn't have all the materials needed for a Cold Heat style iron, so I decided to modify it, and I ended up with another design.

WARNING!

This project involves dealing with electricity and heat. The fact that you are not going to work with thousands of volts does not mean that you won't hurt yourself.

P.S.: English is not my first language, so don't hesitate to tell me if I say something wrong. And don't hesitate to tell me if you have any idea to improve this project. "If you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas", as G. B. Shaw said.

Finally... let's start.

Step 1: What Do I Need? and What Do I Need to Know?


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Bill of materials:

- electrical wires, like those used to connect appliances to wall plugs (you'll need two separate pieces of wire)

- an easily bendable piece of metal (can be really anything... it will become clearer later)

- heat resistant adhesive tape (not strictly necessary)

- "normal" adhesive tape (I used paper tape)

- a PSU (Power Supply Unit, there is one in all desktop computers)

- a pencil

- a pen

Handtools:

- a pair of scissors

- an utility knife

- pliers

- a file (or sandpaper, but a file works better in my opinion)

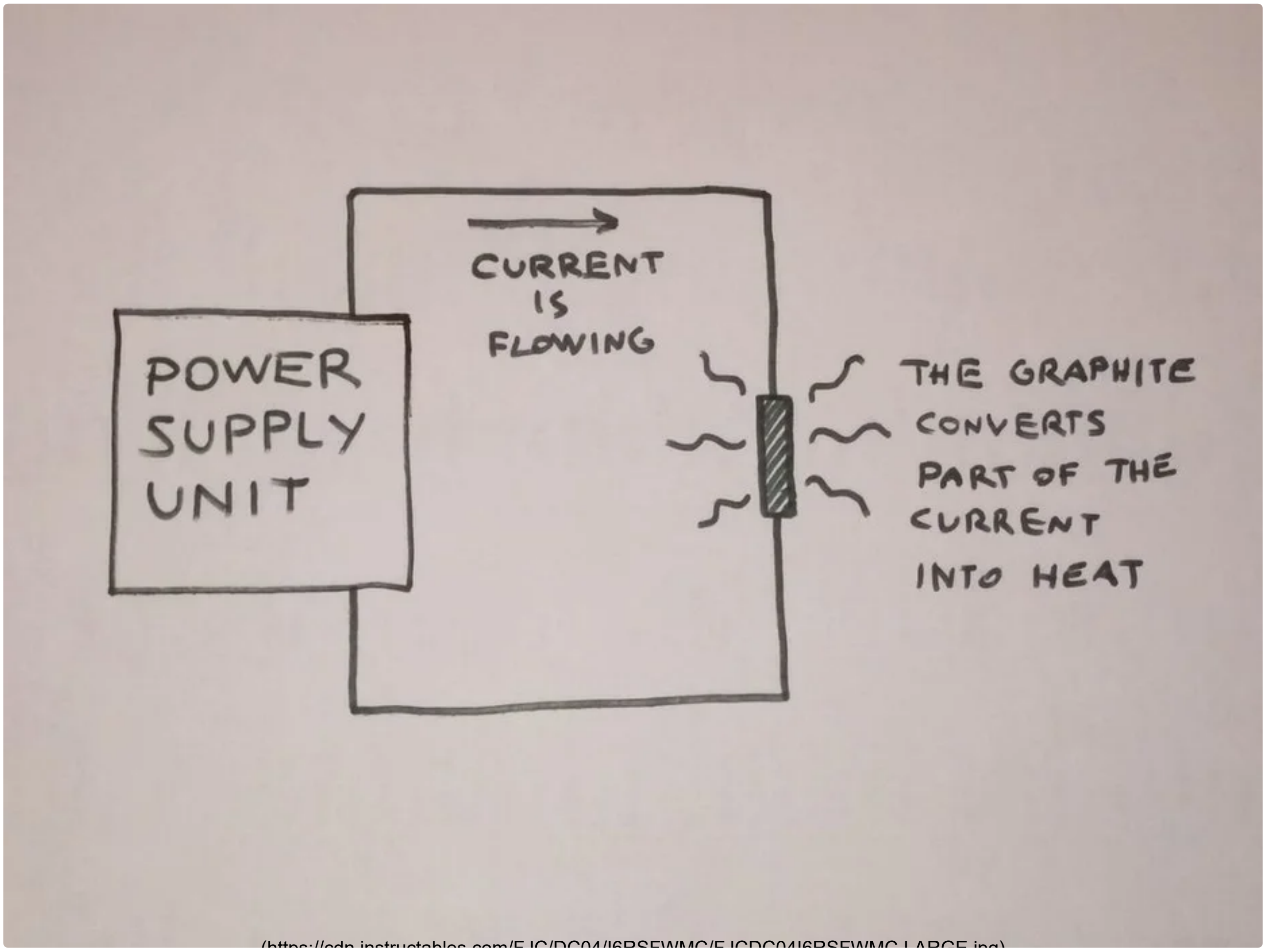
Skills required:

- a bit of creativity

- you should know how to strip electrical wire

This project is quite easy to build, and won't take much time to complete (I spent less than an hour to build it, once I had the materials). However, I understand that some people could find difficulties in gathering some of the materials (ehm... who gave you that weird box with hundreds of wires? NASA?), if they are not used to dumpster dive or don't have a heap of electronic rubbish lying around in their bedroom. Most probably you already have in your home an old pc waiting only for you to dismember it and extract the PSU! You have just thrown it away? Oh... Well, dumpster dive, if you haven't already done it! One man's rubbish... Or ask friends, relatives, classmates (if you have any). Surely one of them has an old computer no longer needed, or knows where you can find what you are searching for. In the unlikely event that, after trying all of these methods, you still are without a PSU, you could ask an electronic retailer. Usually they have many spare parts, and will probably be happy to get rid of a PSU (if asking money, they shouldn't be greedy at all).

Step 2: Working Principle



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If you don't care of this part or already know everything, you can just skip to the next step.

Now... a soldering iron generates heat by making an electrical current pass through a resistance. That's it.

Wait, what is a resistance?

When a current passes through any material, the atoms of this material behave like an obstacle to the electron flow. There is what we can consider as a sort of friction. This friction or resistance, like other kinds of friction, generates heat. So part of the current flowing in every circuit is converted into heat, depending on the resistance of the material it's flowing through (generally speaking, metals have a low resistance while materials like glass or plastic have a high resistance).

This principle is widely used in light bulbs, electric ovens and every kind of electric heaters in general.

To make a circuit of this kind, all we need is something that generates current and something that converts part of it into heat.

At this point, some basic formulas could help understanding better:

Current flowing in a circuit = Voltage of the generator(s) / Total resistance of the circuit

or i = V / R

This formula lets you calculate how much current will flow through a circuit. Let's make an example: we have an AA battery, which outputs 1.5 volts (this is the unit of voltage), and we connect the two poles with a metal wire with a resistance of 1 Ohm (this is the unit of resistance). We don't consider the resistance of the materials of the battery, which is usually very low. The current flowing through this circuit will be approximately 1.5 V / 1 Ohm = 1.5 Amperes (the unit of current). It is important to notice that if we want to increase the current flowing in our circuit, we have to reduce the resistance in that circuit or increase the voltage of the generator.

And here is another formula:

Power dissipated by a material which has a resistance = Voltage applied to this material * Current flowing through it

or P = V * i

This formula lets you figure out more or less how much heat will a piece of any material emit (power dissipated is directly proportional to heat generated). Let's calculate how much power is wasting our metal wire connected to the battery:

1.5 V * 1.5 A = 2.25 W (watts, the unit of power)

In order to increase the power wasted and the heat generated, we have to increase the voltage or the current, or both.

Ok, perhaps I'm only frying your brain with not-so-useful math.

As a power supply we are going to use, well, the Power Supply Unit. And as a resistant material (which will be our tip) we are going to use graphite. As outlined by photozz in his instructable, graphite is a very good material to be used as a soldering iron tip, because it has a low resistance, but not too low a resistance, it decomposes at very very high temperatures (Wikipedia says about 3500 °C), it is very easy to find (ehm... pencils) and very easy to clean as well (the solder doesn't stick to graphite). And it seems to return cold in a very short time if compared to a metal tip.

Our circuit will look like what I drew in the picture. We will connect a wire to the PSU and an end of the tip, and another wire to the PSU and the other end of the tip, in order to make a current flow through it.

Step 3: Making a Tip

First, take the pencil.
Second, take the utility knife.
Third, cut the pencil as shown in the first picture. Repeat the procedure on the other sides of the pencil until the graphite comes out of the wood. It is quite important that the graphite

doesn't come out in dozens of small pieces, so be careful.

Now we have the graphite. But how can we hold it?

Here comes in handy the generic piece of metal. It could be a (preferably thick) wire, or a plate, or a strange piece of odd shape (like the one I used... it was the core of an electromagnet, found in one of those cheap wall clocks). The only requirements are that it can be bent to hold the graphite steadily, and has an end that you can wrap in electrical wire. Use your fantasy.

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Step 4: The Tip Holder

At that moment I didn't have any alternatives, so I used a pen to hold the tip, and discovered that it works quite well (however, some plastics could melt or emit toxic fumes when heated too much. Pay attention to this).
First, remove the internal parts (spring, cartridge, little gear-like components) of the pen. We don't need them.
Second, remove the cap. You will have to disassemble, cut or break it, depending on the pen you are using. Bear in mind that through this hole a wire will pass.
Third, give a careful look at the piece of metal with the graphite. You should put it where the

tip of the pen was. Use the file or cut the pen in whatever shape you need, the important thing is that the piece of metal can be inserted where the tip of the pen was.
Done it? Not yet? Maybe you are going to spend a lot of time thinking about the right way to do it.

When you are done, simply make an electrical wire pass through the pen, wrap it around an end of the piece of metal and make sure they won't disconnect (the best thing would be to solder them, but I assume you don't have a working soldering iron). Now insert the piece of metal into the pen... et voilà! Here is your tip holder. You could wrap the tip in heat resistant tape, but it isn't compulsory to do so.

And yes, my piece of graphite is too long, but we are going to cut it later.

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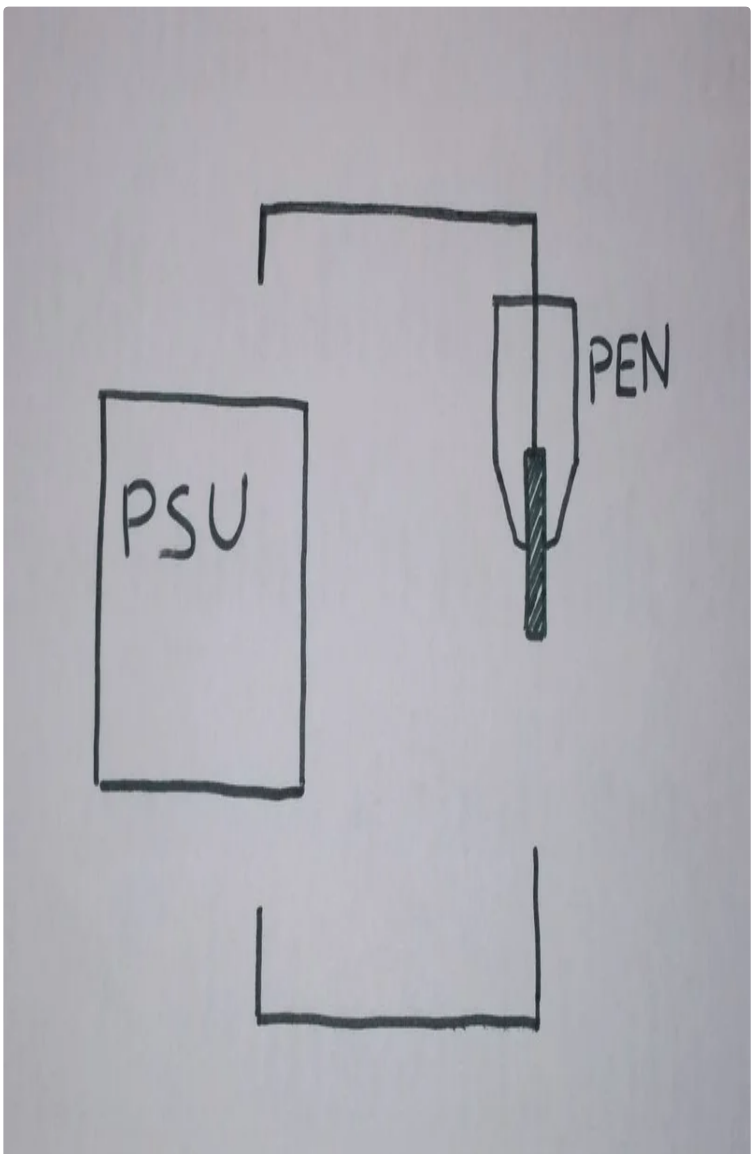
Step 5: Connecting Everything to the PSU



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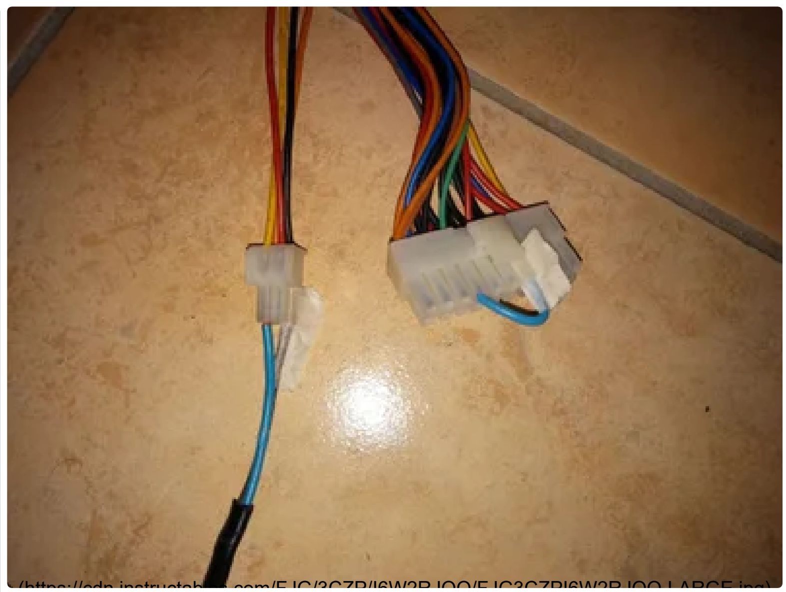

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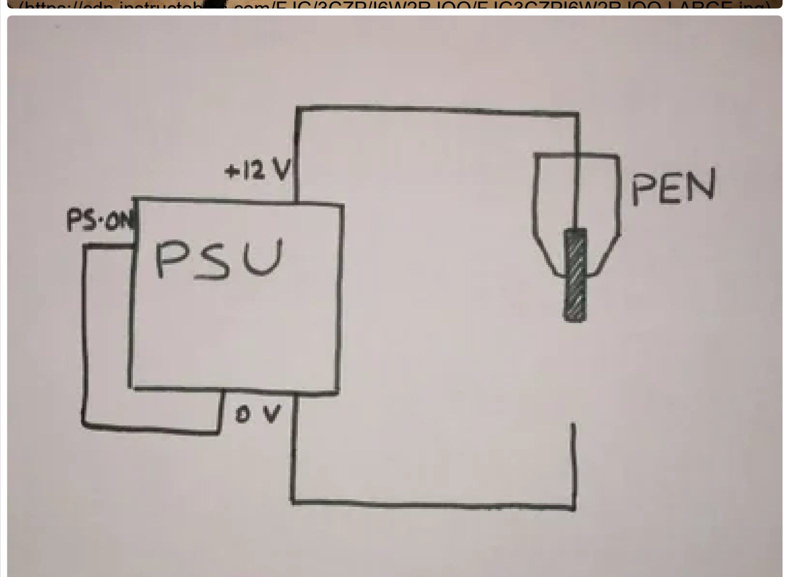

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Tired? The good news are that the difficult part has just finished.

At this point, we should be in the situation shown in the first picture. Now all we need to do is wire the tip to the PSU, which isn't complicated at all, in spite of the hundreds of wires coming out of that box.

On one side of the PSU there should be a legend with all the wire colours explained. Usually, the rail which outputs 12 volts is yellow, 5 volts is red and 3.3 volts is orange, but it isn't always so. There are other colours and rails, but we don't need them. And there is GND, or ground, which is 0 volts. This is important because we will connect a wire to it.

Now look at the amperage (the maximum current they can output). Most PSUs have sufficient amperage to allow the passage of very high currents through your tip, so you can choose whichever rail you want (if, when all is done, your tip doesn't heat, you can simply move to another rail with a higher voltage, remember the first formula? In order to increase the current you have to increase the voltage or decrease the resistance, which means to chop your graphite, because with a shorter piece the resistance will be lower). On my PSU I use a 12 V rail that can output 30 A.

Returning to the PSU wiring, once you have chosen your rail you will have to connect the wire attached to the pen to that rail (I chose 12 V, and so I connected it to a yellow wire), the other wire to ground (leave the other end of this wire free, I will soon explain why), and wrap them in tape, or don't, but wrapping them will keep them more firmly connected (I wrapped only the wire connected to GND, because when I need different voltages I can change rail without unwrapping the other wire).

Certain PSUs won't turn on when plugged in. They need another wire to be connected. Controlling on the legend, you should be able to find a rail named "PS-ON", usually of a weird color like light green. That wire needs to be connected to GND. You can do it with a jumper, or you can put a switch to shut down the PSU without unplugging it. Personally, I prefer to use a jumper and unplug it. And wrap at least one end in tape, in order to keep it firm.

The final situation is shown in the last picture.

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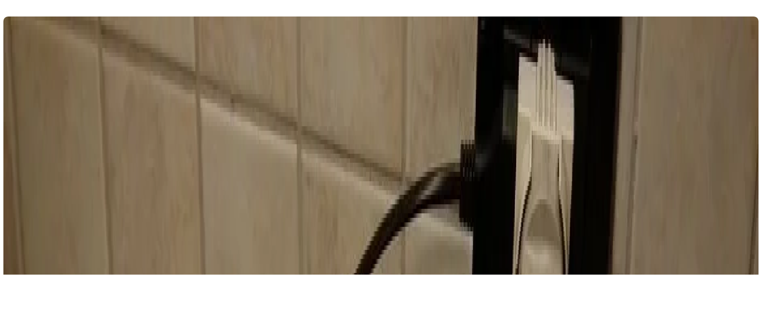
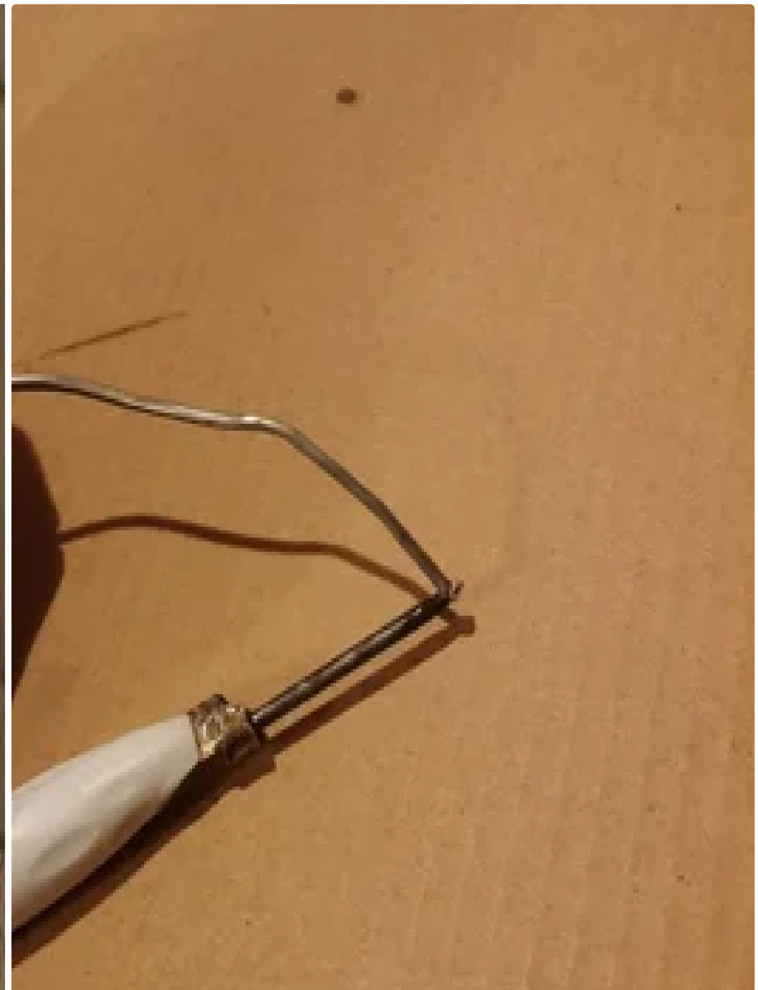
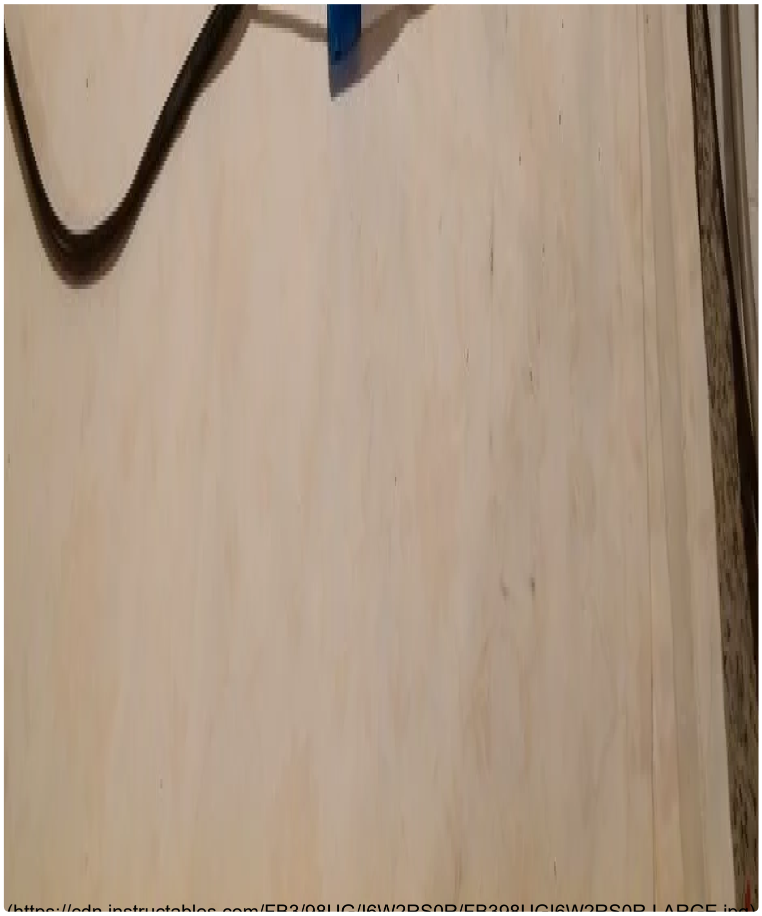
Step 6: Let There Be Light!




POWER SUPPLY
P4-650W





Now your soldering iron is completed!

To heat the tip, simply touch the graphite with the free end of the wire connected to GND (that's why we have left it free). It will heat as long as you keep it in contact with the wire.

You could think this is a drawback, but attach this wire to the solder... and you have a functional iron that stays hot only when the solder is touching the graphite tip (graphite returns cold in seconds). Safety first!

Or you could attach the wire to a screwdriver, or a pair of pliers, and have a rude desoldering iron (pull a pin with the pliers while touching with the graphite the point where it is soldered).

Another big advantage of using graphite is that it can be shaped quite easily: you can make a flat tip, a very sharp tip... the possibilities are endless!

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Step 7: Some Final Caveats

1. Burning in (pun intended!)

The first time you use your soldering iron bear in mind that, together with the graphite, there is also a certain amount of glue. Make it heat gradually, because you will see many strange things happen... the graphite could start to emit fumes (that is the glue evaporating), or bubbles could appear on it (that is the glue boiling), or it could crack (that's due to little bubbles of glue trapped inside, that expand very quickly and break the graphite).

2. Don't make it glow

If you touch your tip with your wire for more than a dozen of seconds (but it depends on the piece of graphite you use, the rail, etc.) it should start to emit light. Never arrive at this point, as the plastic of the pen could emit toxic fumes, your graphite could deform, and the stuff you are working on will be destroyed for sure.

3. There's pencil and pencil

From my personal experience, I have noticed that some kinds of graphite are more conductive than others. High quality pencils like Staedtler (yes, I am so crazy that I dismembered a Staedtler pencil) are way more conductive than low quality ones (perhaps due to a minor amount of glue?). Don't forget this when changing the tip. A new piece of graphite coming from another pencil may heat very quickly, compared to the previous one.

And I warn you against very low quality pencils: they tend to explode as soon as you heat them. Be careful and heat them very very slowly, in order to let the tonnes of glue they put in evaporate gently. But sometimes they will explode anyway.

4. I have seen a big spark and my PSU has stopped working!

One thing you should know is that every PSU has an overcurrent protection, that shuts down the PSU if on a rail is detected a current exceeding the max amperage of that rail. This is only a temporary protection: after some tens of seconds the PSU will return working (however, you could need to unplug and replug it).

If this happens as soon as you touch the graphite with the wire/solder/tool, the resistance of that piece of graphite is too low. Move to a rail with a higher amperage, if possible, or use a longer piece of graphite.

5. I tried to solder a component on the board of my €1500 amplifier and it doesn't work anymore...

Well, if you do such works, it is quite sure you already know, but this kind of soldering iron is not suitable for delicate operations. If you accidentally touch a component on a board with the tip, and another part of the board with the wire, current will try to flow through the board, frying any component that has not been designed to work with such high currents or voltages. You have to be very careful to what you touch, and if you mess around with €1500 amplifiers you should buy a decent soldering station.

My instructable finishes here. I hope I have been clear enough to be understood, if not don't hesitate to tell me.

See you to the next project!